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**A PERSONNEL READINESS TRAINING PROGRAM:
FINAL REPORT**

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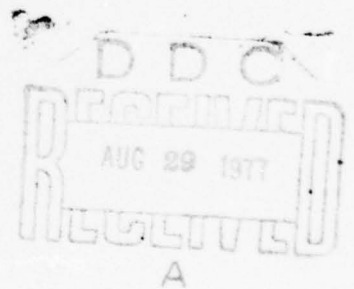
August 1977

A PERSONNEL READINESS TRAINING PROGRAM:
FINAL REPORT

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7 PSI Steam Propulsion Plant. Results from all three areas of application revealed substantial performance deficiencies. Providing testees feedback information with respect to their deficiencies produced some minimal performance changes, but, even where these were statistically significant, they were not large enough to be of any practical significance. Results for groups given remedial training prescriptions varied with the area of application. The ineffectiveness of training prescriptions in some areas appeared to be related to failure to carry out the prescribed training.

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FOREWORD

This Advanced Development effort was conducted in support of Project Z0108-PN (ZPN07), Education and Training Development, under the sponsorship of the Chief of Naval Operations (OP-099). This is the fifth and final report relating to Subproject Z0108-PN.24, Personnel Readiness Training. The first report, NPRDC Special Report 75-8, A Personnel Readiness Training Program: Initial Project Developments, provided an overview of the project. Subsequent reports, NPRDC Technical Report 77-4, A Personnel Readiness Training Program: Operation of the AN/BQR-20A; NPRDC Technical Report 77-19, A Personnel Readiness Training Program: Maintenance of the Missile Test and Readiness Equipment (MTRE Mk 7 Mod 2); and NPRDC Technical Report 77-36, A Personnel Readiness Training Program: Operation and Maintenance of the 1200 PSI Steam Propulsion Plant, described the program in the three areas of application. This final report summarizes findings and conclusions across all three applications. It is primarily intended for use by OP-099 in promoting modifications to training that will increase Fleet readiness.

J. J. CLARKIN
Commanding Officer

SUMMARY

Problem

Personnel who man the Navy's ships are not always capable of adequately performing their assigned duties. To improve personnel readiness, performance inadequacies must be identified and corrected.

Objective

To develop and evaluate a personnel readiness training system designed to provide detailed identification of significant shipboard performance deficiencies and the capability to correct those deficiencies.

Approach

Three areas of application were selected for study: (1) the submarine Sonar Technician operating the AN/BQR-20A, (2) the submarine Missile Technician maintaining the Missile Test and Readiness Equipment (MTRE Mk 7 Mod 2), and (3) the Boiler Technician operating and maintaining the 1200 PSI Steam Propulsion Plant. The experimental design called for three groups of subjects in each area of application: a Control Group, a Diagnostic Feedback Group, and a Diagnostic Feedback + Training Group. All three groups were administered a diagnostic pretest and, after an intervening period of approximately 5 months, the same test was readministered as a posttest.

Findings

In all three areas, pretesting revealed substantial performance deficiencies. Some minimal performance changes were related to receiving feedback, but, even where these were statistically significant, they were not large enough to be of any practical significance. Training materials produced substantial performance gains for the Sonar Technicians operating the AN/BQR-20A. For the Missile Technician and Boiler Technician groups, there was little evidence of improved performance due to training. Ineffectiveness of training materials for the Missile and Boiler Technicians appeared to be due to failure to use the materials assigned.

Conclusions

1. Significant performance deficiencies were present in all three applications of the Personnel Readiness Training investigation.
2. Explicit performance deficiencies can be identified by application of properly designed testing procedures.
3. Performance deficiencies can be corrected through remedial training if training materials and procedures are appropriately used.
4. There is a need to determine specific shipboard training needs and to identify the skills that are best learned aboard ship and those best learned in shore installations.

Recommendations

1. Where personnel performance deficiencies exist with respect to important requirements, the procedures used in this investigation should be considered.

2. The Navy should support studies to determine which skills should be developed aboard ship and which can be acquired more economically ashore.

3. In order to systematically identify significant performance deficiencies, the Navy should proceed with the development of a comprehensive job proficiency assessment system. Such a development has been initiated as Subproject P31, Performance Proficiency Assessment System, under Navy Decision Coordinating Paper, Education and Training Development (NDCP Z0108-PN).

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INTRODUCTION

Problem

Personnel who man the Navy's ships are not always capable of adequately performing their assigned duties (Abrams & Pickering, 1962; Anderson, 1963; Anderson & Pickering, 1959a, 1959b; McLachlan, Thode, Smith, Lane, & Helenihi, 1971). To improve personnel readiness, performance inadequacies must be identified and corrected.

Objective

The objective of this advanced development subproject has been to develop and evaluate a personnel readiness training system designed to provide detailed identification of significant shipboard performance deficiencies and the capability to correct those deficiencies.

Background

The requirement for the Personnel Readiness Training study originated with Venture Team 43, a group of management representatives drawn from both operational and research and development commands for the purpose of identifying Navy personnel problems that might be alleviated by appropriate developmental efforts. One panel of Venture Team 43, chaired by Captain Allen McMichael representing the Chief of Naval Education and Training (CNET), considered training problems. One such problem was that Fleet commanders lacked confidence in the ability of some shipboard personnel to adequately perform significant aspects of their jobs. In 1972, the training panel recommended undertaking the development and evaluation of a system for identifying and correcting shipboard personnel performance deficiencies. The Chief of Naval Operations' Office of Research, Development, Test, and Evaluation (OP 98), agreed to support the study as a subproject of Advanced Development Objective 43-03, and funding was initiated on 1 July 1973.

Four reports have been published on this subproject. One described initial subproject developments (Laabs, Main, Abrams, & Steinemann, Note 1), and the other three presented the results of specific applications (Laabs, Harris, & Pickering, 1977; Laabs, Panell, & Pickering, 1977; Winchell, Panell, & Pickering, 1976). This final report, without repeating all the details in the previous reports, will present a composite picture of the complete study and attempt to assess its significance.

PROGRAM OVERVIEW

The General Model

The main purpose of the Personnel Readiness Training effort was to evaluate a model testing and training program that diagnosed job relevant shipboard performance deficiencies and then provided remedial training. This model is represented by the following general equation:

$$\begin{array}{ccccc} \text{Diagnostic} & & \text{Remedial} & & \text{Enhanced} \\ \text{Testing} & + & \text{Training} & = & \text{Performance} \end{array}$$

Since the focus was on enhanced job performance, tests were constructed to emphasize the demonstration of job skills. Training materials were modularized, self-instructional, and directed toward the correction of identified skill deficiencies.

Areas of Application

Since it was evident that a personnel readiness training study could not deal with all important shipboard tasks, it was necessary to limit the effort to workable proportions. After discussions with representatives of the Chief of Naval Education and Training, the Chief of Naval Technical Training and Navy project managers, it was decided to focus on the study of sets of tasks in three areas of application. The areas were chosen to include both surface and sub-surface personnel and both maintenance and operational tasks. The three sets of tasks were: (1) operation of the AN/BQR-20A by Sonar Technicians on Fleet Ballistic Missile submarines, (2) maintenance of the Missile Test and Readiness Equipment by submarine Missile Technicians, and (3) operation and maintenance of the 1200 PSI Steam Propulsion Plant by Boiler Technicians on cruisers and destroyers. Each of these areas had been suggested to the research team by individuals who believed that performance in the area might be deficient. It was felt that the AN/BQR-20A, a passive real-time frequency analyzer, was not being operated to its full capabilities. The Missile Test and Readiness Equipment (MTRE Mk 7 Mod 2) is very reliable; because of this high reliability, maintenance personnel are provided little opportunity to practice troubleshooting skills. Consequently, it was believed that when troubles did develop technicians might lack the capability to correct them. Various reports indicated that the 1200 PSI steam propulsion plants were plagued by problems, and it was felt that many of these problems were a result of training deficiencies.

Experimental Design

The experimental design called for three groups of subjects in each area of application. These groups were a Control Group, a Diagnostic Feedback Group, and a Diagnostic Feedback + Training Group. All three groups were administered a diagnostic pretest and, after an intervening period of approximately 5 months, the same test was readministered as a posttest. For all groups, the time between pre- and posttest was occupied with regular duties. After the pretest, members of the Control Group were given only a percentage score on how they had performed on the test without any specific feedback. They were not given suggestions or directions as to how their deficiencies might be corrected. Members of the Diagnostic Feedback Group were given specific feedback information

with respect to the performance weaknesses revealed by the pretest but, like the Control Group, they were not provided with any information on how to correct their deficiencies. Members of the Feedback + Training Group were given immediate feedback on their specific deficiencies and then were provided with an appropriate set of training materials to correct individual deficiencies. It was suggested that the time between pretest and posttest be partially occupied in working with those training materials. In the BT application, two ships were asked to have the assigned training materials completed on board ship; the remaining two were asked to have them completed ashore.

Samples

The sampling unit for this study was a ship. Twelve ships were involved for each of the three areas of application: four ships for the Control Group, four for the Diagnostic Feedback Group, and four for the Diagnostic Feedback + Training Group. On each participating ship, all pertinent personnel on board were included in the experimental program. Detailed descriptions of the samples may be found in the earlier reports in this series.

Diagnostic Tests

For each application, a set of diagnostic tests was developed. These tests are described briefly in the following paragraphs. The appendix includes a list of all the testing materials.

For the AN/BQR-20A application, two diagnostic tests were developed; a performance test and a written test. The performance test covered the following tasks: search, contact investigation, tracking, signal-to-noise ratio calculation, and ping interception. The written test comprised 42 items covering knowledge considered essential to the effective operation of the AN/BQR-20A.

For the MTRE Mk 7 application, four diagnostic tests were developed: a preventive maintenance test, a corrective maintenance test, a simulated troubleshooting test, and a test equipment test. The preventive maintenance test consisted of three problems in which the testees were required to perform various maintenance checks on the actual MTRE equipment. The corrective maintenance test consisted of two troubleshooting problems on the MTRE equipment. The simulated troubleshooting test was a paper-and-pencil test designed to measure the ability of the MT to logically apply his knowledge of equipment maintenance. The test equipment test, using a specially designed test-signal generator to provide inputs, involved use of the AN/USM-281A oscilloscope, the John Fluke 803D/AG differential voltmeter, and the Simpson-volt-ohm micro-ammeter Model 269-2.

Two diagnostic tests were developed for the 1200 PSI Steam Propulsion Plant application. The first of these was a multiple-choice test on basic mechanical skills and knowledges. The second test was a multiple-choice test on the use of the Engineering Operational Sequencing System (EOSS).

Remedial Training Materials

Remedial training materials, based on job task analyses, were assembled or developed for each of the three applications. These materials were packaged

in such a way that they could be assigned in relatively small modules to match areas of weakness revealed by the diagnostic tests. The appendix includes a list of the training materials. The reader should refer to earlier reports for a detailed description of these materials.

RESULTS AND DISCUSSION

Administrative Consideration

The conduct of any Fleet study, no matter how designed or executed, places demands on Fleet personnel that are beyond the scope of their normal duties. In these austere times, shipboard manning is minimal at best. Therefore, it is not surprising that Fleet Commands at all levels, from Fleet Commanders in Chief to ship's captains, are reluctant to add to the burdens of their personnel in order to promote projects that may or may not have beneficial results in the future. Because of these considerations, if the study were to be done at all, it was necessary to accept conditions that were undesirable from a strictly experimental point of view. For example, some of the assignments of ships to control or experimental groups in the submarine samples were made for the convenience of Fleet personnel rather than on a strictly random basis. In the case of the BTs, original plans called for the shipboard administration of certain hands-on performance tests. These performance tests were not used because it was found that they would place an unacceptable additional burden on the ships involved. There is no doubt that these experimental difficulties hindered the conduct of the research; however, their actual effects on research results cannot be precisely determined.

Another critical problem with respect to the measurement of shipboard performance concerned determining where performance should be measured. It can be argued that the most appropriate place and time for such measurement would be at the actual job site while the performance is being carried out during regular shipboard operations. Although this would certainly provide the greatest face validity, there are many other factors to be considered. For example, to get comparable measurements across a set of subjects, each subject must be given an opportunity to perform a standard task under standard conditions and that performance must be observed, recorded, and interpreted. The requirement for a standard task immediately rules out observation of performance in a natural setting, unless the task under consideration is one performed on a very frequent basis. While observers have been used on board ship in the past to collect performance data, shipboard observation is a very costly process and one that is likely to substantially interfere with normal shipboard duties. Thus, all of the testing done as part of this study was carried out on shore, either in a specially equipped van located at dockside or at various training facilities. Any widespread application of diagnostic testing procedures similar to the ones described here would probably require a similar approach.

Performance Deficiencies

Results from all three areas of application revealed substantial performance deficiencies. The apparent reasons for these deficiencies varied with the area of application. For the Sonar Technicians operating the AN/BQR-20, it appeared that appropriate training had never been given, either in schools or on board ship, nor had an adequate operator's manual been provided. For Missile Technicians operating the Missile Test and Readiness Equipment, the nature of the equipment appears to have contributed indirectly to training deficiencies. The MTRE Mk 7 is very reliable and, typically,

one MT is assigned primary responsibility for that equipment during a specific patrol. The reliability of the equipment together with the limited assignment of maintenance responsibility provide the setting for the skill deterioration that occurs with nonuse. The problems of the Boiler Technicians operating the 1200 Pound Steam Propulsion Plant no doubt have many origins including insufficient numbers of personnel, propulsion systems that are to some extent unique to each ship, and, for some propulsion system team members, inadequate basic training.

Feedback

It should be recognized that the term "feedback," as used in the Personnel Readiness Training study, had a limited and specific meaning. It meant providing an individual information about inadequacies in either his job understanding or his job performance. The effects of providing feedback information to others who might make decisions about personnel practices was not studied. Thus, supervisors, personnel managers, and school administrators were not part of a feedback loop.

In the present case, in order for feedback to have resulted in beneficial changes in performance, the individual concerned would have had to act on the information he was given in such a way as to change his performance in the desired direction. Apparently, some minimal performance changes were related to receiving feedback. However, even where these were statistically significant, they were not large enough to be of any practical significance. The results indicate that informing an individual that his performance is deficient in some specific way is not by itself sufficient to produce important improvements in performance.

Remedial Training

As indicated in the section on experimental design, for each area of application investigated there were three groups of subjects: (1) a Control Group, (2) a Diagnostic Feedback Group, and (3) a Diagnostic Feedback + Training Group. The results for the groups given both diagnostic feedback and remedial training prescriptions differed with the area of application. In the BQR-20A application, the remedial training materials were utilized, and that utilization produced significant improvements in measured aspects of job performance. With respect to the MTRE Mk 7 application, the training group showed no differentially greater improvement in performance with respect to any one of the four diagnostic tests. When an attempt was made to determine the reasons for this training ineffectiveness, it became evident that most of the 19 MTs in the training group did not recognize a need for the training and therefore did not complete their assigned lessons. This was confirmed both from self-reports during the posttesting and from progress checklists that were returned by supervisors from the four submarines in the training group. Only five MTs could be identified as having completed their assigned lessons. When the performances of the MTs who had completed the training were compared with that of comparable men in the other two groups, the results, although based on extremely small samples, suggest that, had training been completed, performance would have improved.

As with the MTs, the BTs in the training group showed little evidence of improvement due to training. Here, too, it was found that assigned training had not been completed; only 21 percent of the BTs completed their assigned modules. Special analyses of results on the very small subsamples that had completed training do suggest that if training had been completed, performance would have improved. There were evidently two main reasons for nonuse of the training materials by the BT group: a lack of time to do training on board ship and the poor shipboard study environment. The BTs who were asked to complete training at a shore site completed a far higher percentage of assigned materials.

Other factors may have contributed to differences in the extent to which training materials were used in the three applications. For example, the BQR-20A materials were probably the most directly related to job performance, they were packaged in briefer lessons than the others, they were designed so that the majority of the training could be done while the STs were standing watch, and STs evidently recognized a need for training in the areas covered.

Implementation of a Personnel Readiness Training System

The purpose of the Personnel Readiness Training subproject was to develop and evaluate a system for the identification and correction of shipboard performance deficiencies. The three areas of application investigated were selected as characteristic problem areas. Based on the results from these areas, the system appears to be successful both in diagnosing performance deficiencies and, where training materials are used, in improving job performance. However, if the Personnel Readiness Training concept is to be maximally useful to the Navy, steps must be taken to make the system operational. Figure 1 outlines the major components of the Personnel Readiness Training system. It is evident that, if the system is to be made operational, the agency or agencies responsible for implementing various aspects of the system will have to be identified and funds must be allocated to support the program.

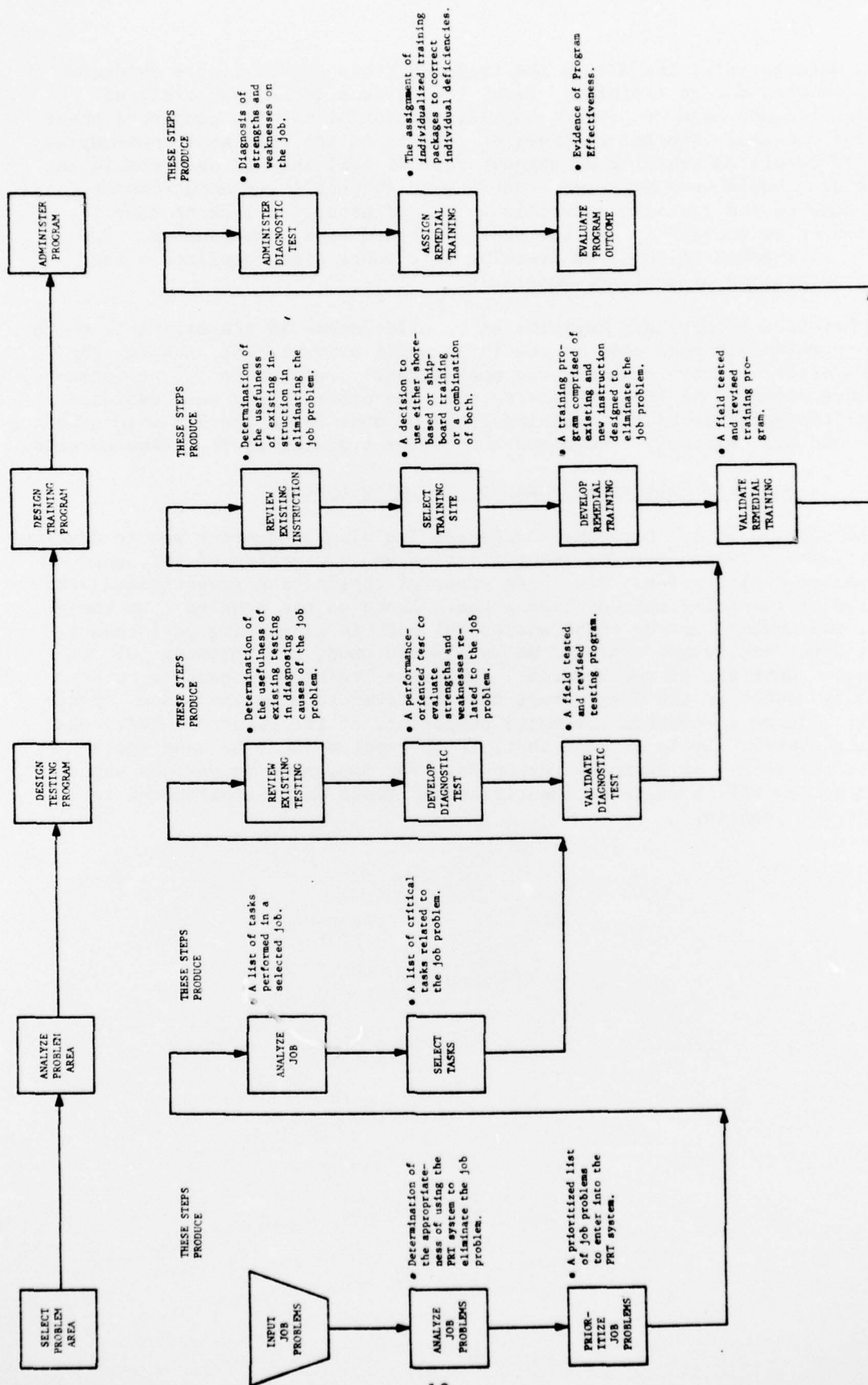


Figure 1. Personnel Readiness Training System.

CONCLUSIONS

1. Significant performance deficiencies were found in all three applications of the Personnel Readiness Training investigation. It is probable that comparable deficiencies exist in relation to many other Fleet job skills.
2. Explicit performance deficiencies can be identified by application of properly designed testing procedures.
3. Identified performance deficiencies can be corrected through appropriate use of pertinent remedial training materials and procedures. However, simply providing shipboard personnel with appropriate training packages is not enough. Time and space for training must be made available and job incumbents must be motivated to engage in the training process.
4. There is a need to determine specific shipboard training needs and to identify the skills that are best learned aboard ship and those best learned in shore installations.

RECOMMENDATIONS

It is recommended that:

1. Where commands believe a personnel performance deficiency exists with respect to important requirements, the procedures used in this investigation should be considered. In this case, responsibilities should be designated and steps taken to develop a mechanism, similar to that shown in Figure 1, to assure that diagnostic testing/remedial training packages are made available to help correct specific critical skill deficiencies.
2. The Navy should support studies to determine which skills should be developed aboard ship and which can be acquired more economically ashore.
3. In order to systematically identify significant performance deficiencies, the Navy should proceed with the development of a comprehensive job proficiency assessment system. Such a development has been initiated as Subproject P31, Performance Proficiency Assessment System, of Advanced Development Z0108-PN.

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APPENDIX

TESTING AND TRAINING MATERIALS DEVELOPED AS PART OF
THE PERSONNEL READINESS TRAINING SUBPROJECT

TESTING AND TRAINING MATERIALS DEVELOPED AS PART OF
THE PERSONNEL READINESS TRAINING SUBPROJECT

AN/BQR-20A Application

1. Written Test (42 items): Knowledges Essential for Proper Operation of the AN/BQR-20A.
2. Performance Test (13 problems): Operation of the AN/BQR-20A.
3. Modularized shipboard training package on AN/BQR-20A. (Consists of six written lessons, five logic trees, and six drills to be used in conjunction with two 1/4" training tapes.)

MTRE Mk 7 Application

1. Test Signal Generator (TSG) for use with test equipment training and testing materials. (Provides for the generation of discrete AC and DC electrical signals that simulate signals that may be detected and measured on electronic equipment.)
2. Preventive Maintenance Test (3 problems): Performance of standard preventive maintenance procedures.
3. Corrective Maintenance Test (2 problems): Troubleshooting the actual MTRE equipment.
4. Simulated Troubleshooting Test: Five Decision Measurement System (DMS) exercises/tests on troubleshooting MTRE. (These are paper-and-pencil in format and involve step-by-step solution of troubleshooting problems. Latent-image techniques are utilized for solution masking and response feedback.)
5. Test Equipment Test: Skill Proficiency Examination on use of Test Equipment. (Includes operation of AN/USM-281A Oscilloscope, John Fluke 803D/A6 series AC/DC Differential Voltmeter, and Simpson Model 269-2 Volt-Ohm-Microammeter.)
6. Self-study workbook on MTRE Maintenance Checks. (Consists of eight modularized lessons.)
7. Self-study workbook on MTRE Troubleshooting Techniques. (Consists of six modularized lessons.)
8. Self-study workbook on Use of Test Equipment. (Ten modularized lessons on Oscilloscope, John Fluke Meter, and Volt-Ohm-Microammeter.)

1200 PSI Steam Propulsion Plant Application

1. Multiple Choice Basic Mechanical Procedures Test for Boiler Technicians (104 items): (Keyed to 13 core modules developed by Propulsion Engineering School, Great Lakes, and adapted for on-board training by CNET.)

2. Performance test on Use of Engineering Operational Sequencing System (EOSS).

3. Self-study workbook on Review of Safety Precautions.

4. Programmed text on Use of EOSS.

5. Motion picture film on EOSS--Its Uses and Advantages.

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